**CCSBT-ESC/2409/15**
**(ESC Agenda item 7.1 and 7.4)**

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# Update on Australian otolith collection, ageing and the SRP ageing workshop 2024

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CCSBT-ESC/2409/15

Prepared for the CCSBT Extended Scientific Committee for the Twenty Ninth Meeting of the Scientific Committee

2-6 September 2024

## Acknowledgments

There are many people we would like to acknowledge for their support. Our thanks go to Seatec Pty Ltd for collecting otoliths as part of routine collecting from the South Australian tuna farms in Port Lincoln under AFMA supervision. Our appreciation also goes to Kyne Krusic-Golub and Admir Sutrovic (Fish Ageing Services) for sectioning and reading the otoliths, and Scott Cooper for database support. This work was funded by AFMA and CSIRO Environment.

## 1.1 Abstract

This report provides an update on the southern bluefin tuna (SBT) otolith collection and ageing activities in Australia in 2024, along with plans for the SRP ageing workshop. Otoliths from 177 SBT caught in the Great Australian Bight (GAB) by the purse seine fishery in 2023 were received and archived in the CSIRO hard-parts collection. Age was estimated for 100 of these fish and the data were provided to the CCSBT in 2024. An additional 148 otoliths sampled in 2024 have recently been received but are not yet archived.

The SRP ageing workshop planned for early 2024 was postponed due to logistical challenges. However, preparatory work is underway. This includes daily age estimation of 100 otoliths from small fish to determine otolith size-to-daily age relationships and verify annual growth zone locations. Additionally, annual age estimation is being conducted on 15 otoliths from tagged-recaptured SBT, some of which have been at liberty for over 30 years, to validate current ageing protocols. Work is also progressing to confirm the time of year when opaque and translucent zones are deposited in otoliths through increment measurements and marginal increment analysis. We aim to reschedule the workshop for later this year.

## 1.2 Introduction

Since the 2002 fishing season, Australia has been obliged to provide annual length-at-age estimates for the surface (purse seine) fishery in the Great Australian Bight (GAB) to CCSBT. The current protocol requires that all farm operators provide a sample of 10 fish that have died either in towing operations or within the first weeks after fish have been transferred to stationary farm cages. A company contracted to the Australian Fisheries Management Authority (AFMA) measures the length of each fish and extracts the otoliths from these mortalities. In the past there have been between ~25 and 40 tow cages a year, giving a total of 250-400 otoliths collected from this sector each season. In recent years, however, the number of fish available for otolith sampling has declined primarily because of low mortalities in the cages during the towing operations (Farley et al., 2013).

## 1.3 Otolith sampling and reading

A total of 177 sets of otoliths were collected from the Australian surface fishery in the 2023 fishing seasons by Seatec Pty Ltd. The fish were measured to the nearest cm (fork length, FL) and the otoliths removed and sent to CSIRO in Hobart. The size range of fish sampled was 61 to 95 cm FL, with one larger fish at 142 cm FL (mean 83.6 cm FL) (Figure 1).

A total of 100 otoliths were selected for ageing using a length-stratified sampling strategy rather than random sampling. This approach ensured age estimates were obtained from all length classes, including those with small sample sizes. One otolith from each fish was sent to Fish Ageing Services Pty Ltd (FAS) in Victoria for weighing, sectioning, and reading. Transverse sections were prepared for each otolith following established protocols (Anon., 2002). Opaque zones were counted along a transect running from the first inflection point to the edge of the otolith. An opaque zone on the otolith margin was counted only if fully formed, with translucent material visible between the last opaque zone and the otolith edge. Prior to reading each year's otoliths,

FAS read an ageing reference set (n=61 sectioned otoliths) for calibration purposes. FAS then read the selected 100 otoliths at least twice without referencing previous readings, fish size, otolith weight, or capture date. A confidence score was assigned to each otolith reading. A customized image analysis system was used to record an image of the otolith section, measure the distance from the primordium to the distal edge of each counted opaque zone, and measure to the edge of the otolith. A final age (count of opaque zones) was obtained for all 100 otoliths selected for ageing. Ages ranged from 1 to 4 years, except for the largest SBT, which was 7 years old. The length to age relationship is presented in Figure 2. The age data were provided to CCSBT in 2024.

An additional 148 otoliths sampled in 2024 have recently been received but are not yet archived or aged.

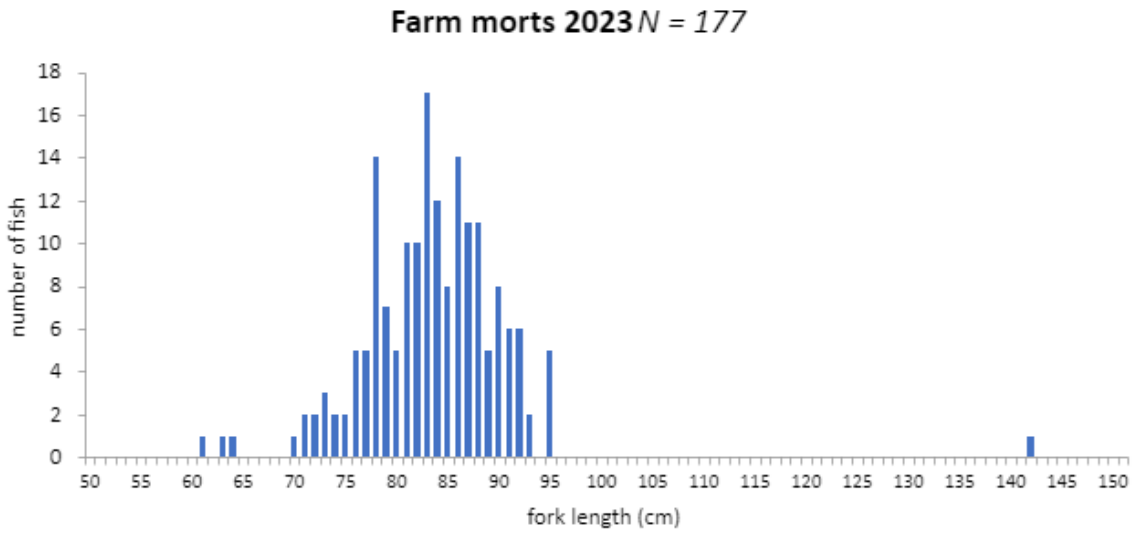


**Figure 1. Length frequency of SBT with otoliths sampled from the Australian surface fishery in 2023.**

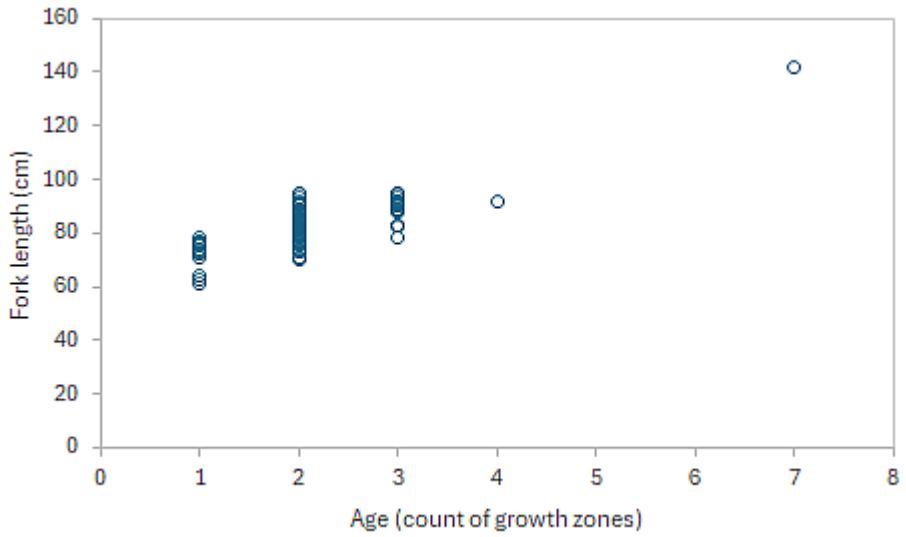


**Figure 2. Length-to-age (zone count) relationship for SBT caught in 2023.**

## 1.4 SRP ageing workshop

An otolith-based ageing workshop for SBT planned for early 2024 was postponed due to logistical challenges, included a short turnaround time and limited availability of individuals from member countries. We aim to reschedule the workshop for later this year. Appendix 1 provides the draft agenda for the workshop.

Despite the delay, several initiatives are underway in preparation for the workshop. Firstly, 100 otoliths from small fish (42-79 cm FL) have been selected for daily age estimation. These samples are important for two reasons: (i) determining the otolith size-to-daily age relationship required for estimating fractional age, and (ii) verifying the location of the first counted annual growth zone in otoliths and vertebrae for annual ageing. The otoliths were collected between 2001 and 2023, potentially allowing for an examination of changes in juvenile growth over this period, although the sample size is relatively small. FAS is currently reading these otoliths.

Secondly, 41 otoliths from tagged-recaptured SBT have been selected for annual age estimation by FAS. This selection includes specimens that were at liberty for close to 30 years. Most fish were tagged as small juveniles, allowing for age-at-release estimation based on length-at-release data. By adding the time-at-liberty, these SBT become “known age” fish making their otoliths critical for validating the current ageing protocol. The otolith samples will also be valuable additions to a new otolith age calibration set.

Finally, work is progress to measure annual increments in otoliths and conduct marginal increment analysis (MIA). This analysis will help confirm the time of year when opaque and translucent zones are deposited in otoliths.

# References

Anonymous. (2002). A manual for age determination of southern bluefin Thunnus maccoyii. Otolith sampling, preparation and interpretation. The direct age estimation workshop of the CCSBT, 11-14 June 2002, Queenscliff, Australia, 39 pp.

Farley, J., Eveson, P. and Clear, N. (2013). An update on Australian otolith collection activities, direct ageing and length at age in the Australian surface fishery. CCSBT ESC-1208-18.

*Second CCSBT workshop on otolith-based ageing of southern bluefin tuna*

**Background**

Quality control of age data is extremely important to ensure high quality age estimates are generated for assessment and management needs. It is also important to standardise approaches for converting increment counts to age estimates (including decimal ages) across Member laboratories. The last technical age estimation workshop for southern bluefin tuna (SBT) was conducted in 2002 (Anon 2002). In 2014, a second SBT age estimation workshop was proposed to re-evaluate the precision and bias among otolith readers and standardise approaches to interpreting the otolith edge and converting increment counts to decimal age estimates amongst member laboratories (Farley et al., 2014). In 2022, the need for an ageing workshop was reiterated, emphasising the need for pre-workshop inter-laboratory otolith exercises (Farley 2022). The overarching goal of the workshop is to improve age-based parameters for assessment and management advice for SBT. The aim is not to provide comprehensive training for new otolith readers.

**Objectives**

- Improve age estimation protocols and quality control procedures.
- Discuss and standardise methods to calculate decimal age.
- Revise the age determination manual including methods related to reading otolith margins.
- Provide capacity building training for Members who have not been involved in SBT age estimation.

**Date and Venue**

Date: XXXX

Venue: CSIRO Marine Laboratories

3-4 Castray Esplanade, Battery Point, Tasmania, 7004 Australia

Members to pay their own travel and accommodation expenses.

**Expected participants**

Specialists in ageing SBT from CCSBT Member countries. Participants are encouraged to bring their own otolith samples/images for discussion of age estimation methods.

**Tentative Agenda**

<u>Pre-workshop:</u>

An otolith image exchange and reading exercise will be undertaken for inter-laboratory calibration (n=30 otoliths). Images will be available at least 6 weeks prior to the workshop. Readings by participating members will be due two weeks prior to the workshop.

Fish Ageing Services (FAS; Australia) will also prepare, daily age and measure otoliths from 100 small SBT to (i) confirm the location of the first opaque zone and (ii) assist decimal age estimation following Farley and Clear (2021).

<u>Day 1: Introduction, reading protocols, otolith exchange results</u>

- Welcome and introductions
- Goals of the workshop
- Overview of the 2002 ageing workshop
- SBT ageing methods and validation by each Member laboratory (all hardparts)
- Results of otolith intercalibration exercise
- Identify sources of ageing errors from the exercise

Day 2: Daily ageing, guidelines to improve interpretation, decimal age calculation and

- Guidelines to improve otolith interpretation:
    - Summary of FAS daily age data and identification of the first opaque zone
    - Identification of subsequent opaque zones
    - Otolith edge interpretation (examine the annual cycle of zone formation)
    - Standardise number of readers and readings per otolith
    - Can some field data be provided during reading (capture date, length, sex)?
    - Otolith image capturing, marking and measuring
- Decimal age calculation
- Further research required
- Re-read otolith exchange images (if time permits)

Day 3: Discussions and reporting

- Reach consensus on protocols for age estimation
- Update otolith reference collection with agreed ages
- Revise the age determination manual (during the workshop or prepare a future schedule)
- Workshop reporting
- Close of workshop

**References**

Anon (2002) A manual for age determination of Southern Bluefin Tuna, *Thunnus maccoyii*: Otolith sampling, preparation and interpretation. A product of The Direct Age Estimation Workshop of the Commission for the Conservation of Southern Bluefin Tuna, 11 – 14 June 2002, Queenscliff, Victoria, Australia, 36 pp. https://www.ccsbt.org/sites/ccsbt.org/files/userfiles/file/docs_english/operational_resolut ions/age_determination_manual.pd

Farley J (2022) An update on Australian otolith collection activities and direct ageing activities for the Australian surface fishery – 2022.

Farley J and Clear N (2021) An update on Australian otolith collection activities and direct ageing activities for the Australian surface fishery. CCSBT-ESC/2108/11. CCSBT-ESC/2208/13.

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